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Standing “the Watches” with Armed UAVs

By

Francis R. McCulloch  
CDR, U.S. Navy

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

Signature \_\_\_\_\_

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Lt. Col. Joe Dill  
Faculty Advisor

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## **STANDING “THE WATCHES” WITH ARMED UAVS**

### **Introduction**

The interest and investment in Unmanned Aerial Vehicles (UAVs) throughout the United States Department of Defense is immense. Between the services, over 1.1 Billion dollars has been budgeted in Fiscal Year 2003 for UAV systems with 693 Million dollars earmarked for research and development.<sup>i</sup>

“Quite likely, we could now be designing our last manned aircraft.”<sup>ii</sup>

*Secretary of the Navy, the Honorable Gordon R. England*

Open almost any military news publication or news report on the war in Afghanistan and you would likely find an article concerning the UAV. The capabilities of this family of weapon systems seem to grow faster than the space available to report on them. They have been used for surveillance, bomb damage assessment (BDA), as an airborne Close Air Support Forward Air Controller (FAC (A)), and beginning on 04 February 2002 as a weapon delivery platform. Clearly, the successful engagement of a ground target by a Predator UAV firing an AGM-114K Hellfire missile has added a new lethal capability for the operational commander to employ. Other milestones achieved during the war in Afghanistan include the first combat employment of the U.S. Air Force Global Hawk, a long endurance high altitude UAV, and the direct link of real-time video from the Predator to AC-130 Gunships.

Unmanned Aerial Vehicle programs are gaining wide support and funding even as the military services are looking at programs to cut from the budget. Each military service currently has UAV programs in operation or development and Congress is supporting the program with ever-increasing funding. Even the President of the United States stressed the importance of

UAVs in a speech made to the Citadel when he said that the Predator was a good example of a transformational program and that “this unmanned aerial vehicle is able to circle over enemy forces, gather intelligence, transmit information instantly back to commanders, then fire on targets with extreme accuracy.”<sup>iii</sup> Internationally, there are 55 nations operating some 80 types of UAVs, primarily for reconnaissance.<sup>iv</sup> The future for further development is bright.

This author believes that the Unmanned Aerial Vehicle with its new capabilities being demonstrated and refined in Afghanistan can alter the way this country currently conducts “presence and monitoring” operations such as Operations Southern Watch or Northern Watch, resulting in a greater economy of effort, greater ability to maneuver and returning the element of surprise to our forces. Additionally, the author believes that the proper employment of UAVs can lead to a reduction of assets currently employed in the conduct of these operations, reducing the risk to aircrews now tasked with this mission.

This paper will briefly review the recent history (Gulf War to present) of the UAV and current systems available to support the operational commander. It will also briefly explore the direction the different services are taking in their approach to UAV employment. Current capabilities that the operational commander can employ as well as current limitations will be analyzed. Finally, recommendations for employment of UAVs in presence operations will be explored.

### **The Historical Trail to the Armed UAV**

UAVs have been used by the U.S. military in various capacities since the Sperry/Curtiss N-9 in 1917.<sup>v</sup> They flew over 3430 sorties in Vietnam.<sup>vi</sup> Naval RQ-2 Pioneer UAVs were used in Operation Desert Storm with great success and provided a near real time surveillance capability in a high threat environment. They provided 52% of Naval Gunfire Support (NFGS)

spotting and virtually all BDA for battleships operating off Kuwait. Additionally, the Pioneer was used to gather intelligence in preparation for a possible amphibious assault and used for reconnaissance around the assembled ships. The first-ever recorded surrender of enemy troops to an unmanned aircraft occurred during this time frame when hundreds of Iraqi soldiers were seen waving white flags to the Pioneer.<sup>vii</sup> It was this demonstrated capability that lead to the interest and further development that resulted in the systems fielded today.

The RQ-1 Predator began in 1994 as an Advanced Concept Technology Demonstration (ACTD) project and was the first such demonstration project to successfully transition to production and fielding.<sup>viii</sup> In 1997, the program transitioned to the Air Force with the stand-up of two operational squadrons at Indian Springs Auxiliary Field, Nevada.<sup>ix</sup> Unlike the Navy's Pioneer that is classified as a Tactical UAV, the Predator is a medium altitude, long endurance system that can fly an advertised range of up to 400 nautical miles and loiter on station for greater than 16 hours. It is equipped with sensors including various cameras, synthetic aperture radar and, most recently, a laser designator providing a capability to designate targets for attack.<sup>x</sup> The Predator deployed to Bosnia in 1996 where it provided surveillance and monitoring of the situation on the ground. In Operation Allied Force, the Predators operated as remote-controlled ISR platforms. They enabled the operational commander conducting the air war to see the situation on the ground and provided continuous coverage of important areas. During this conflict, tactics were developed and refined to use the Predator to locate and track enemy forces and to cue attack aircraft. It was also used for near real-time BDA, allowing timely re-strike capability.<sup>xi</sup> As a direct result of the capabilities demonstrated by the Predator in tracking and identifying targets and the limitations also demonstrated in not being able to engage those same targets, U.S. Air Force General John Jumper directed efforts to field a weaponized UAV.<sup>xii</sup>

In the Department of Defense (DOD) Kosovo / Operation Allied Force After Action Report to Congress, it was stated under *Needed Improvements* that “although UAVs were used effectively during Operation Allied Force, a number of technical improvements are still needed to attain the full promise of these systems. In addition, DOD needs to improve the tactics, techniques and procedures that guide UAV employment to better integrate their operations into overall campaign plans.”<sup>xiii</sup>

## **Current UAV Situation**

Each U.S. military service employs various UAV systems. Except for those operated by the Air Force, the systems are no longer in production and are scheduled to be replaced in the near-term future. Additionally, systems now in use by the Army, Navy and Marine Corps are tactical systems supporting elements below the operational commander. The Army and Marine Corps are concentrating their future efforts on systems that directly support their fielded forces at the tactical level. The Navy is developing both tactical and operational level systems to support maneuver “from the sea”. To support long range surveillance and other missions, the Navy is seeking to incorporate the Global Hawk into their operations. They have asked for funding for two Global Hawks in the FY '03 budget.<sup>xiv</sup> Only two current UAV systems, both operated by the Air Force, are capable of performing at the operational level and will be discussed further. They are the Predator and the Global Hawk.

The U.S. Air Force has continued to improve and develop the capabilities of the Predator since operations conducted in Kosovo. The first test shots of the AGM-114K Hellfire Missile from the Predator were conducted in February 2001 and were successful for stationary targets.<sup>xv</sup> Tests using realistic tactics and against moving targets were delayed first by funding and then by

operations in Afghanistan. The capability to down-link video from the Predator directly to AC-130 Gunships was recently developed to support Operation Enduring Freedom.<sup>xvi</sup>

The Air Force has established its first armed Predator squadron to be fully mission capable by 2005, and is looking to give all its existing Predators an armed capability.<sup>xvii</sup> They will receive the first production version armed Predator in late 2002.<sup>xviii</sup> Testing is ongoing to refine armed Predator capabilities and to explore other weapons that the Predator could employ. Airframe performance enhancements and additional sensor capabilities are also being researched, tested and funded.

In addition to the Predator, the U.S. Air Force presently operates the RQ-4 Global Hawk, another successful Advanced Concept Technology Demonstration (ACTD) project. It was designed to provide wide-area coverage (up to 40,000 square miles per day) in a high altitude / long endurance airframe. It currently can carry a 1,950 pound payload and remain airborne for 36 hours<sup>xix</sup> although improvements are currently funded to expand the payload to 3,000 pounds.<sup>xx</sup> The Global Hawk first flew in 1998 and is currently operating in Afghanistan where it recently flew a record-setting 26 hour surveillance mission. Unlike the Predator which is constantly flown by trained aircrew operating at a ground control station, the Global Hawk is pre-programmed for flight. However, the mission can be changed in flight if necessary. It is equipped to carry an array of sensors including Electro-Optical (EO) / Infrared (IR) cameras and Synthetic Aperture Radar (SAR). It is capable of simultaneous use of EO/SAR or IR/SAR with Ground Moving Target Indicator (GMTI).<sup>xxi</sup> The Air Force envisions the Global Hawk as an eventual replacement for the U-2 long-range, high endurance surveillance platform.

To support operational concepts development for current UAV systems, the Air Force established a UAV Battlelab in 1997 at Eglin AFB, Florida. The battlelab's goal is to "explore and demonstrate the worth of innovative UAV operational concepts (as distinct from new

systems or tactics) in key emerging areas.”<sup>xxii</sup> The Air Force UAV Battlelab is currently conducting numerous initiatives for both Predator and Global Hawk UAVs.<sup>xxiii</sup>

## **Significant Challenges to UAV Employment**

Although largely successful and certainly newsworthy, the employment of UAVs in military operations has not been trouble-free. The vehicles themselves have several technical difficulties that must be resolved before their true capabilities will be realized. More important to the operational commander is the comprehensive doctrine development that must capture the capability that UAVs provide. Joint Forces Command is moving in that direction with the establishment of the Joint Operational Test Bed System to explore UAV and C4I interoperability concepts and procedures for the joint warfighter.<sup>xxiv</sup>

A major obstacle to the introduction of more and more capable UAVs is satellite availability. For both Operation Allied Force in Kosovo and again in Operation Enduring Freedom in Afghanistan, the United States was forced to lease bandwidth on commercial satellites to meet the communication requirements for the theater. In Afghanistan, available satellite links limit the number of UAVs that can be employed simultaneously to two Predators and one Global Hawk. This is less than the operational commander could effectively employ and less than the physical assets available in theater to support the operation.<sup>xxv</sup> In addition, the Global Hawks have had to turn sensors off and transmit video with reduced quality to conserve satellite capacity. Even with the planned launch of three additional military wide-band “gap-filler” satellites starting in 2004, the ability to maximize UAV employment will be limited by available bandwidth and will still require leased commercial satellite space.<sup>xxvi</sup>

The Predator, employed continuously in operations since 1996, failed its DOD operational test and evaluation for a variety of reasons. Listed operational deficiencies such as

poor target location accuracy, ineffective communications and inability to operate in weather were cited. The U.S. Air Force conducted its own evaluation in October 2001 and determined the Predator to be “effective but not without limitations and difficulties” and “suitable though reliability and maintainability problems persist”.<sup>xxvii</sup> Despite the serious technical issues, the Predator is in high demand and its employment is increasing. Testing on the armed Predator concept is still incomplete but currently planned. Weapons other than the Hellfire missile are being looked at as is the ability to engage moving targets.

The Global Hawk is still in the testing phase even though it is in operation in Afghanistan. Serious concerns for this system include rising costs and reliability. Three have crashed (two destroyed / one damaged on landing) since the program began approximately four years ago, resulting in an accident rate far exceeding that of comparable manned platforms.<sup>xxviii</sup> One of only two Global Hawks available to support operations in Afghanistan crashed returning from a mission leaving only one available for the theatre. At more than 15 million dollars apiece, not including sensors, the accident rate is alarming. In addition, the Air Force is concerned about the growing costs of sensors associated with the UAVs.<sup>xxix</sup>

Other significant issues with UAV employment are operational vice technical in nature. Primarily, these issues deal with Command and Control of the UAV and who is tasking the operators. Army Major General Franklin Hagenbeck, the commander of regular U.S. ground forces in Afghanistan, commented in an interview that the transmission of live video images to multiple locations made staffs above his own feel they were in a position to get involved in the battle.<sup>xxx</sup> Another problem identified in the fighting was the inability to directly communicate with the UAV operators who could be hundreds or thousands of miles away from the commander.<sup>xxxi</sup> Additionally, there is a real danger that focusing attention to the narrow field-of-view that the Predator provides (seeing the battle through a soda straw) will make the chance of

missing something more important more likely. The fidelity of the information provided by the Predator is excellent as compared to other sensors but the area it can cover is extremely small.

### **Presence and Monitoring, Brief History of “the Watches”**

On 28 February 1991, President George Bush announced a cease-fire ending the Gulf War. In April of the same year the United Nations passed Resolution Number 688 that demanded Iraq to immediately end repression of its civilian population. In response to this resolution, Operation Provide Comfort began in order to assist the Kurdish population in Northern Iraq. Iraq was warned by the U.S. Government that no Iraqi aircraft were to fly north of the 36<sup>th</sup> Parallel. In August 1992, in response to Iraq’s attacks on Shiite civilians in the South, President Bush announced Operation Southern Watch which banned Iraqi flights south of the 32<sup>nd</sup> Parallel. In December 1992, and January 1993, Iraqi military aircraft violating the no-fly zones were shot down. Also in January 1993, the United States, Britain, France and Russia issued a joint ultimatum to Iraq, demanding the removal of all surface-to air missiles south of the 32<sup>nd</sup> Parallel. This was followed up later that same month with strikes on 32 Iraqi missile sites and command centers.<sup>xxxii</sup> On 15 October 1994, the United Nations Security Council adopted Resolution Number 949 that demanded that Iraq remove recently deployed military units that threatened Kuwait and to not take any action to enhance its military capacity in Southern Iraq.<sup>xxxiii</sup> In response to this Resolution, President Clinton imposed a “no-drive” zone in Southern Iraq that effectively banned significant movements of military equipment south of the 32<sup>nd</sup> Parallel.<sup>xxxiv</sup> In September 1996, the United States increased the area of the southern no-fly zone to the 33<sup>rd</sup> Parallel. In December 1996, Operation Provide Comfort ended and was replaced by Operation Northern Watch.<sup>xxxv</sup>

A review of the United States European Command's unclassified website shows that in Northern Watch alone, coalition aircraft have been fired upon approximately 193 times since 1991 and have responded in some way almost every time. These responses have varied from the launching of anti-radiation missiles against the corresponding missile sites to coordinated attacks on command and control centers. Also according to the website, there are approximately 1,400 personnel and 45 aircraft currently involved in the mission.<sup>xxxvi</sup> With the added mission of defending Kuwait and the Gulf nations, Operation Southern Watch's numbers are far greater. Although Iraq has never been successful in its attempt to down a coalition aircraft, it has tried on numerous occasions. They have maintained a fairly robust air surveillance and anti-air defense capability despite coalition operations. It is safe to say that billions of dollars and thousands of manned aircraft sorties have been expended in monitoring Iraq since the Gulf War ended. It is also safe to say that numerous coalition aircrews have been put at risk to enforce the restrictions placed on Iraq.

Unarmed Predator UAVs have been involved in operations over Iraq for several years. Primarily, they have been used for near real-time BDA of manned aircraft strikes, target area observation, aimpoint refinement and surveillance. They have frequently been overhead strikes in progress giving instant results to the operational commander. They have tracked and located possible targets but until now, have been unable to engage. The links providing Predator video to the Combined Air Operations Centers (CAOC) conducting Operations Southern Watch and Enduring Freedom are in place and functioning.

### **Armed UAV Operational Possibilities**

If properly employed, the development of an armed capability for the Predator and other UAVs could positively affect the military conduct of both the "Watches". They could assume

*some* of the missions currently conducted by manned aircraft, reducing the risk to coalition aircrew. They could conduct missions considered too risky at present such as strikes inside missile engagement zones, strikes north or south of the no-fly boundaries and strikes in high collateral damage areas. If used to their developing potential, they could increase the accuracy and timeliness of strike operations. With their long on-station loiter times, they could greatly increase the coverage now available using manned surveillance platforms. Their use, in place of manned aircraft formations could actually be de-escalatory without a corresponding loss of capability. The introduction of armed UAVs in the theater would reduce predictability; at least in the short term. However, in order to capture the benefits of this increased capability, certain changes must occur in the way operations are conducted.

One distinct advantage of the armed UAV is that the *sensor is the shooter*. Inaccurate coordinates or errors in passing and entering coordinates between platforms have been responsible for friendly-fire injuries and unintended collateral damage in recent conflicts. Using the capabilities of the armed UAV greatly reduces the chance for human error. Additionally, the relatively slow speed at which the UAV operates and the ability to stay on station without risking aircrews allows more time to determine the value of the target, refine the best aimpoint, and evaluate possible collateral damage concerns. With its long loiter time, the UAV can wait, if necessary, for the situation on the ground to develop favoring an attack. *Operational maneuver is increased.*

Historically, with notable exceptions, the Coalition's response to Iraqi engagement of patrolling aircraft has been to target air defense weapon systems in the no-fly zones. Usually, the responses have been coordinated multi-aircraft strikes using expensive precision munitions against comparatively less expensive and often non-operational systems. Employing the armed UAV in this area would help balance the cost-versus-gain ratio and allow a better determination

(again due to the UAV's speed and loiter ability) that the intended target is in fact an operational system. *Operational fires are more effective.* Opponents of this approach could argue that a Hellfire equipped Predator or similar armed UAV could not achieve the levels of damage comparable to a coordinated manned-aircraft strike. While this argument is true on the surface, the armed UAV could, in most ground attack missions currently conducted in "the Watches", achieve the damage levels required. *Economy of Force is emphasized.*

In October 1962, America almost went to war with the Soviet Union over the introduction of nuclear missiles in Cuba. President John F. Kennedy allowed the release of secret surveillance photographs showing the missile deployments in order to influence public opinion that this country was justified in its actions. The current Predator UAV provides a recordable video history and could be used in the same way. Video of substantial troop movements could alert coalition members and influence world opinion. The video could dispute claims of civilian injuries and collateral damage, validate war crimes and document violations of the Laws of Armed Conflict. Particularly damaging documentation of the enemy locating military equipment near mosques or in civilian areas could garner support in the Gulf area. *Operational intelligence is enhanced.*

Currently, flight operations in both "the Watches" are not conducted continuously. With its air surveillance capability, the Iraqi military is aware of coalition air activity with enough warning to alter its operations and prepare a response. The Predator is capable of far greater on-station times and could be on station between manned aircraft operating cycles or even continuously. The UAV could be employed to elicit a desired response from the enemy in situations of our choosing. One such example would be to draw Iraqi fighters into range of our own. Additionally, by arming some UAVs, the opposing force would have to assume all UAVs were possibly armed. *Operational deception is certainly a possibility.*

Although not specifically mentioned earlier in the discussion on UAV capabilities, testing is underway to use the Predator as a remote sensor delivery platform and as a platform for directed leaflet distribution.<sup>xxxxvii</sup> These capabilities could aid in shaping the battlefield or influencing local populations. The expanded use of UAVs coupled with the reduction of manned aircraft in monitoring operations could be considered de-escalatory to countries concerned with our presence in the theater.

## **Current Considerations to UAV Employment**

The greatest capability that the armed UAV brings to the operational commander is the ability to instantly engage targets of opportunity when and where located. The additional capability to transmit video to multiple locations and multiple levels of command makes the employment decision more challenging. In order to successfully take advantage of this near real-time engagement capability, the commander in charge of executing a particular operation must have the authority to “pull the trigger” when a valid target is identified, without consulting with higher echelons of command. Rules of engagement (ROE) should be clearly defined with this instant engagement capability in mind. Historically, the United States has preemptively attacked air defense elements in both Iraqi no-fly zones based on hostile intent by mere presence and self defense arguments. The ultimatum issued in January 1993 for Iraq to remove its surface-to air missiles from south of the 32<sup>nd</sup> Parallel has never been rescinded, only selectively enforced.

A significant limitation to full employment of an armed UAV capability is communication with the UAV operators, sometimes far removed from the commander. This link will become critical to the conduct of time-critical evolutions. With communication capacity already stretched in every theater, a dedicated direct link between the UAV operators and the

operational commander is costly but absolutely necessary. The UAV operators should have clear, concise ROE to employ weapons when appropriate.

The UAVs currently available for employment are hard to track, harder to spot and as a result, relatively hard to engage. However, their current loss rate would be unacceptable for manned aircraft. As of December 2001, approximately 20 of the first 60 Predators produced had been lost to mishaps, weather or enemy action.<sup>xxxviii</sup> One explanation for the high combat loss rate is their employment in situations considered far too risky for manned aircraft. They will not survive a dedicated, uninhibited air threat. Their slow speed, mentioned previously as an asset, makes them incapable of outrunning a pursuing fighter. They will need protection from air defense fighters on strip alert to perform effectively. Depending on the UAV's operating area, these support aircraft may need to be airborne but could be held on deck until actually needed. Additionally, the requirement for long-range surveillance cannot currently be replaced by the limited number of Global Hawk UAVs. Finally, the defense of Kuwait and other Gulf nations requires a significant deployed force that a UAV will not be capable of replacing. They can, however, reduce the numbers of manned aircraft currently flying "Watch" missions.

### **Proposed UAV Dominated Mission**

The current United States-led Coalition has flown "the Watches" for the past ten years, using various combinations of manned aircraft. The requirement for many of those manned aircraft could be eliminated by adopting a UAV dominated mission. The Airborne Early Warning and Control (AWACS) and Rivet Joint Electronic Surveillance aircraft would both still be needed as well as their complement of tankers and fighters. Missing from the day's Air Tasking Order (ATO) would be the U-2 surveillance missions and their support packages consisting typically of approximately three sections of air defense fighters, a division of F-16CJ

electronic attack aircraft, one or two EA-6B electronic attack aircraft, and a division or more of various types of ground attack aircraft. Also missing are approximately four to six large tankers required to support these aircraft. In the U-2's place would be a Global Hawk UAV conducting surveillance in the respective no-fly/no-drive zone. Fighter aircraft would be on alert, launching only if needed and without their extensive tanker requirements. Also airborne would be several armed Predator UAVs with defined areas of interest to patrol. Based on previous missions or current intelligence, the Global Hawk could search for possible Surface-to-Air Missile (SAM) sites recently relocated in the no-drive zone. After the Global Hawk found a possible site, the Predators would be sent by the CAOC to investigate and determine if site was manned and appeared operational. With previously defined ROE determining that the presence of SAM sites in the no-fly zone was a demonstration of hostile intent, and determining that collateral damage was not a factor, the operational commander could engage the critical component of the site. The armed Predator would be able to loiter in the area long enough for the operational commander to make a determination that the site was indeed real and that collateral damage concerns were considered. Also critical to the targeting process was the fact that no time-consuming aimpoint refinements were needed and targeting data did not pass to another platform, greatly reducing the chance for error. Considering one possible negative outcome for this event, the loss of the Global Hawk or Predator, the extensive Combat Search and Rescue package, consisting of helicopters, fighters and ground attack aircraft would not be required. In Operation Northern Watch, these replaced aircraft could re-deploy elsewhere as required. In Operation Southern Watch, they would still be needed in defense of the Gulf Nations but would not be placed at risk flying "Watch" missions. Considering the risk versus gain ratio in conducting hostile "presence" operations, the increased use of UAVs makes sense.

## **Conclusion**

Armed Unmanned Aerial Vehicles can be compared to the modern-day patrol cop in any major city. He can't be everywhere but he knows the trouble spots. He is sent on patrol *to look* for trouble. He is armed with both a weapon and a radio to call for back-up if necessary. More and more, his police cruiser is equipped with a camera to record his actions for further investigation. He has the authority to use deadly force if he feels it is necessary, without having to wake the chief. He understands collateral damage concerns (hot pursuit rules and hostage situations). His mere armed presence serves as a deterrent. He has the SWAT team available if the situation gets out of hand. And finally, if he were a UAV, he could do all this while sitting in the donut shop having coffee.

The armed UAV can increase the flexibility and capabilities of the operational commander charged with conducting “presence and monitoring” operations. It can reduce the risk to aircrew in manned aircraft that would be called to perform the same mission. It can't do everything but it can be an effective, lethal tool in the commander's toolbox. Critical to the successful employment of armed UAVs is a command and control structure that matches their capabilities.

## **Recommendations**

The following recommendations are presented for consideration by both UAV providers and operators.

- Continue developing and testing armed Predator capabilities against both stationary and moving targets. Develop capabilities for employing additional weapons other than the Hellfire

missile. Develop training plans for operators as well as employment guidance for commanders.

Incorporate armed Predator operations into training exercises.

- Deploy the armed Predator and Global Hawk to “the Watches” when available. Assign trained, knowledgeable personnel to the CAOC to support armed Predator operations.

Incorporate armed Predators into both current no-fly zone operations. Record “lessons learned” for follow-on programs and doctrine development. Due to the additional defense responsibilities inherent in Operation Southern Watch, recommend deploy first to Operation Northern Watch to determine if the armed Predator can, in fact, enable a reduction of manned strike aircraft.

Conduct a UAV dominated mission as a validation test.

- Ensure Rules of Engagement maintain the flexibility to employ armed Predators effectively. Consider classifying target categories that could be engaged without submission to higher headquarters for approval.
- Ensure secure, continuous communications between the UAV operators and the CAOC.
- Clearly delineate controlling chain-of-command both above and below the operational commander. Consider limiting live video feeds to only those individuals who have a clearly defined need. Consider giving the UAV controllers an unlisted telephone number where they can't be reached except through the operational commanders' staff.
- Ensure military communication satellites are adequate in quality and quantity to support existing and future UAV systems in every theatre.
- Although not directly related to this study, consider establishing a joint UAV project office to oversee all development and procurement for the DOD in order to ensure the efficient use of funds and reduce unnecessary duplication of effort by the individual services.

## NOTES

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<sup>i</sup> Marc Strass, "Services Provide Over \$1Billion For UAV Development, Deployment," C4i News, 14 February 2002, 1.

<sup>ii</sup> Gordon R. England, "Remarks," Association of Unmanned Vehicle Systems International Conference, 31 July 2001,  
< <http://www.chinfo.navy.mil/navpalib/people/secnav/England/speeches/uav010731.txt> > [30 April 2002].

<sup>iii</sup> George W. Bush, "President Speaks on War Efforts to Citadel Cadets," Remarks by the President at the Citadel, 11 December 2001,  
< <http://www.whitehouse.gov/news/releases/2001/12/20011211-6.html> > [28 April 2002].

<sup>iv</sup> Department of Defense, Unmanned Aerial Vehicle (UAV) Roadmap 2000-2025 (Washington, DC: 2001), 12.

<sup>v</sup> Ibid.,i.

<sup>vi</sup> Ibid.

<sup>vii</sup> Department of Defense, Final Report to Congress on the Conduct of the Gulf War, (Washington, DC: 1992), 212.

<sup>viii</sup> U.S. Air Force, "RQ-1 Predator Unmanned Aerial Vehicle," Fact Sheet,  
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<sup>ix</sup> Ibid.

<sup>x</sup> "Unmanned Aerial Vehicle (UAV) Roadmap 2000-2025," 3.

<sup>xi</sup> Department of Defense, "Report to Congress," Kosovo/Operation Allied Force After-Action Report, (Washington, DC: 2000), 56.

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